Mobile networks service quality measurements in Montenegro

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Service quality of the mobile networks in Montenegro were made during the december 2017 and january of 2018.

Measuring equipment:

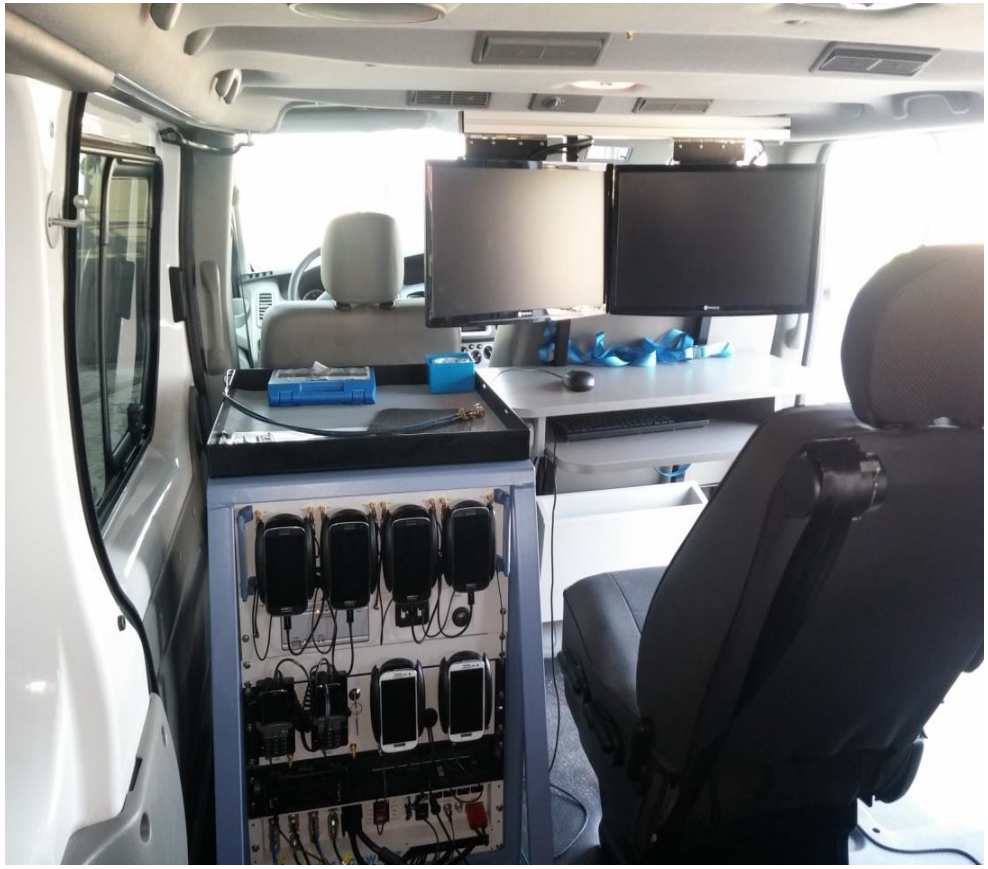
- 3 Samsung S3 measuring terminals – voice service measurement
- 3 Samsung NOTE 4 measuring terminals – data service measurements
- Roof mounted antennas – all terminals use seperate antenna
- Measuring software for colecting samples: ROMES and Nemo Outdoor
- Measuring software for analysis: Network Problem Analyser and Nemo Analyze

Gathering of the measurement samples:

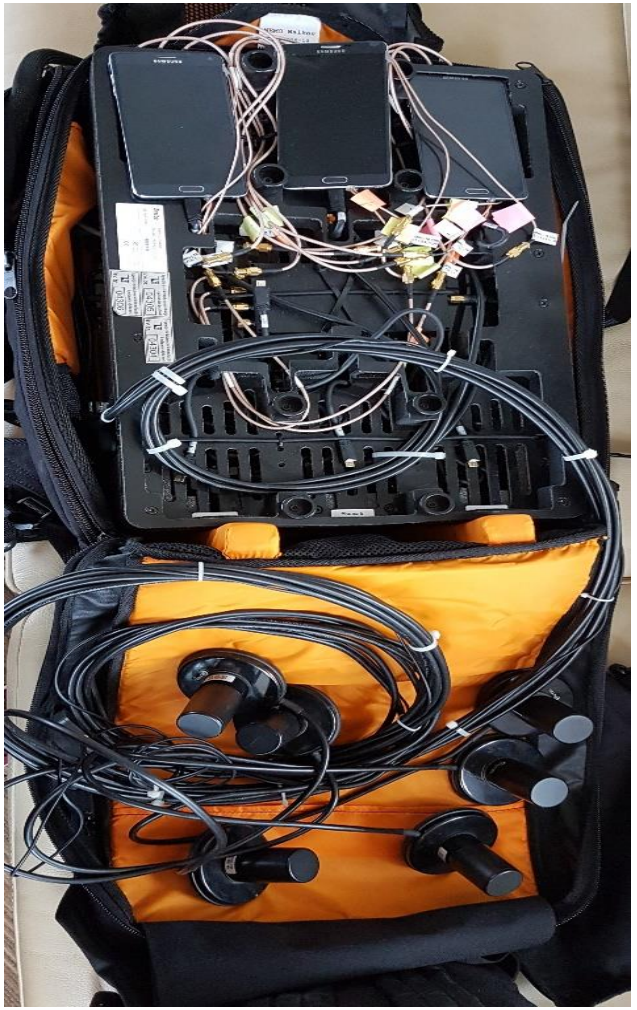
- 100% drivetest, all operators are measured in the same time, all measurement terminals are set to auto mod so they can use any network technology which is avaliable in these part of the route

Samples, analysis and results view were made on the basis of ETSI TS 102 250 standard and Rulebook on the quality of public electronic communications services in Montenegro („Official Gazette of Montenegro", nb. 02/18).

Digital mobile control and measuring station (DMKMS)



Measurement system in DMKMS (ROHDE & SCHWARZ)



Measuring system Anite NEMO Walker II

Voice service measurement settings:

- Three measuring terminals Samsung S3 that make calls to answering machines. Each mobile operator have answering machine installed in the network
- Maximal time for making call conection 15s, call duration 60s, pause between the calls 15s. In one word, call windows 90s,
- For voice service four parameters are measured:
  Radio Network Unavailability (no service – no network),
  Telephony Service Non-Accessibility (block call),
  Telephony Setup Time and
  Telephony Cut-off Call (droop call)

Data service measurement settings

- Three measuring terminal Samsung Galaxy Note 4 that make connection to operator packet networks,
- Test SIM cards which did not have speed or data quantity limits for download or upload so they used maximal network capacity during the measurement,
- Mobile operators had obligation to provide undisturbed acces to FTP servers (no limitation in the sence of speed or acces rights) from above mentioned mesuring terminals,
- Measuring terminals were connecting to FTP servers which are instaled in te mobile operator networks performing upload and download of the test files. For FTP download as a sample is used 10 GB file and the session time was resticted on 15s. For the upload as a sample is used 100 MB file and the session time was restricted on 20s. In bouth cases maximal time for the server connection was restricted on 15 s,
- Web browsing (HTTP download) was tested by connecting to dinamic web sites www.rtcg.me, www.blic.rs which are in the group of 10 most visited sites from Montenegro and connecting to static Kepler web sites which are placed on server in operator network

- For data service 12 parameters was measured:

Attach Success Ratio (GSM, UMTS, LTE),
PDP Context Activation Success Ratio (GSM, UMTS),
PDP Context Cut-off Ratio (GSM, UMTS),
EPS bearer allocation success ratio (LTE),
FTP IP-Service Access Success Ratio,
FTP {Download|Upload} Data Transfer Cut-off Ratio (drooped session),
HTTP browsing IP-Service Access Success Ratio,
HTTP browsing Data Transfer Cut-off Ratio (drooped session),
FTP data rate download,
FTP mean data rate download per session,
FTP data rate upload,
FTP mean data rate upload per session.

RESULTS ANALYSIS

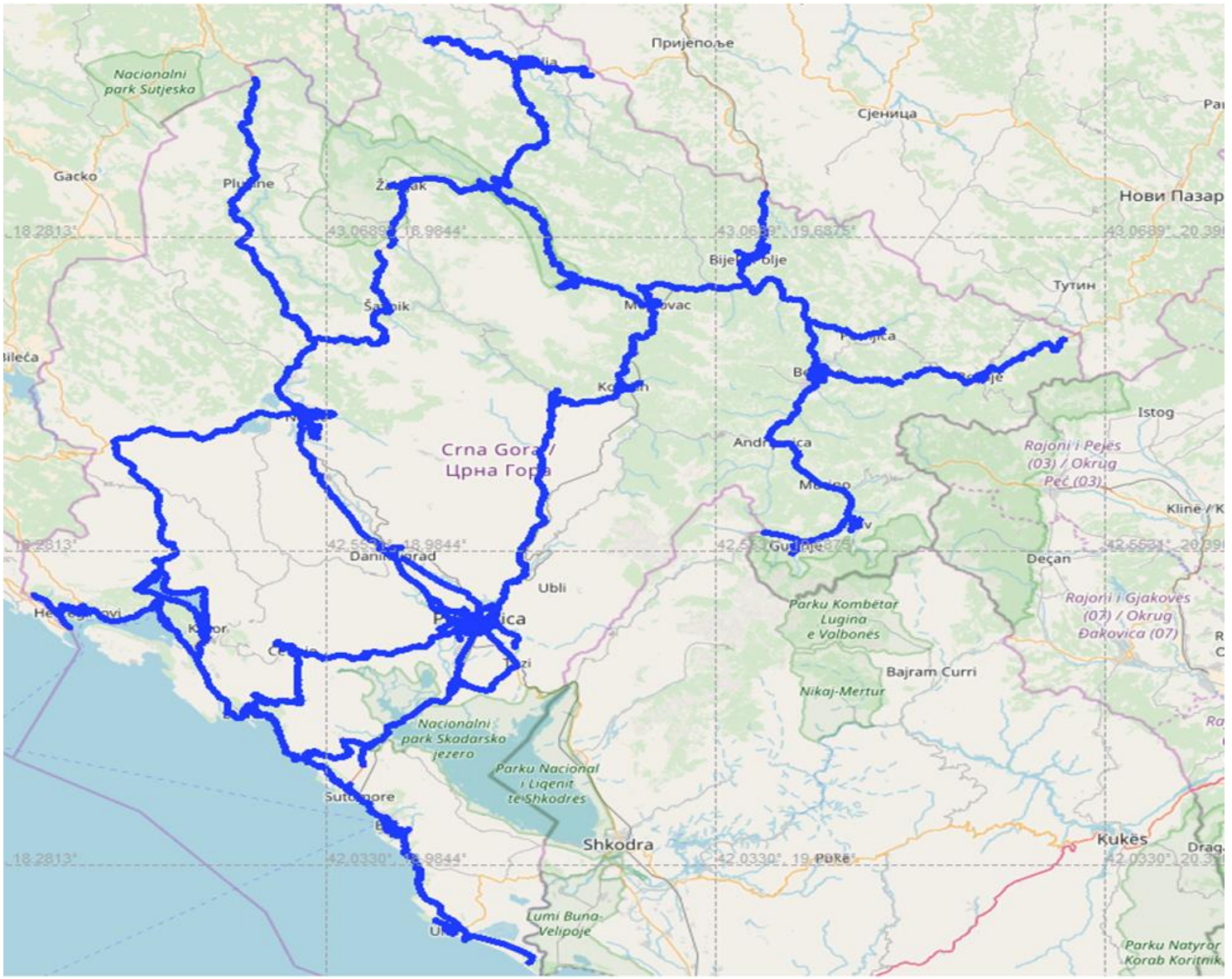
❖Results analysis for voice service, for cities and roads appropriate number of the samples was taken so the width of confidence interval be smaller then 3% for the result confidence level 95%.

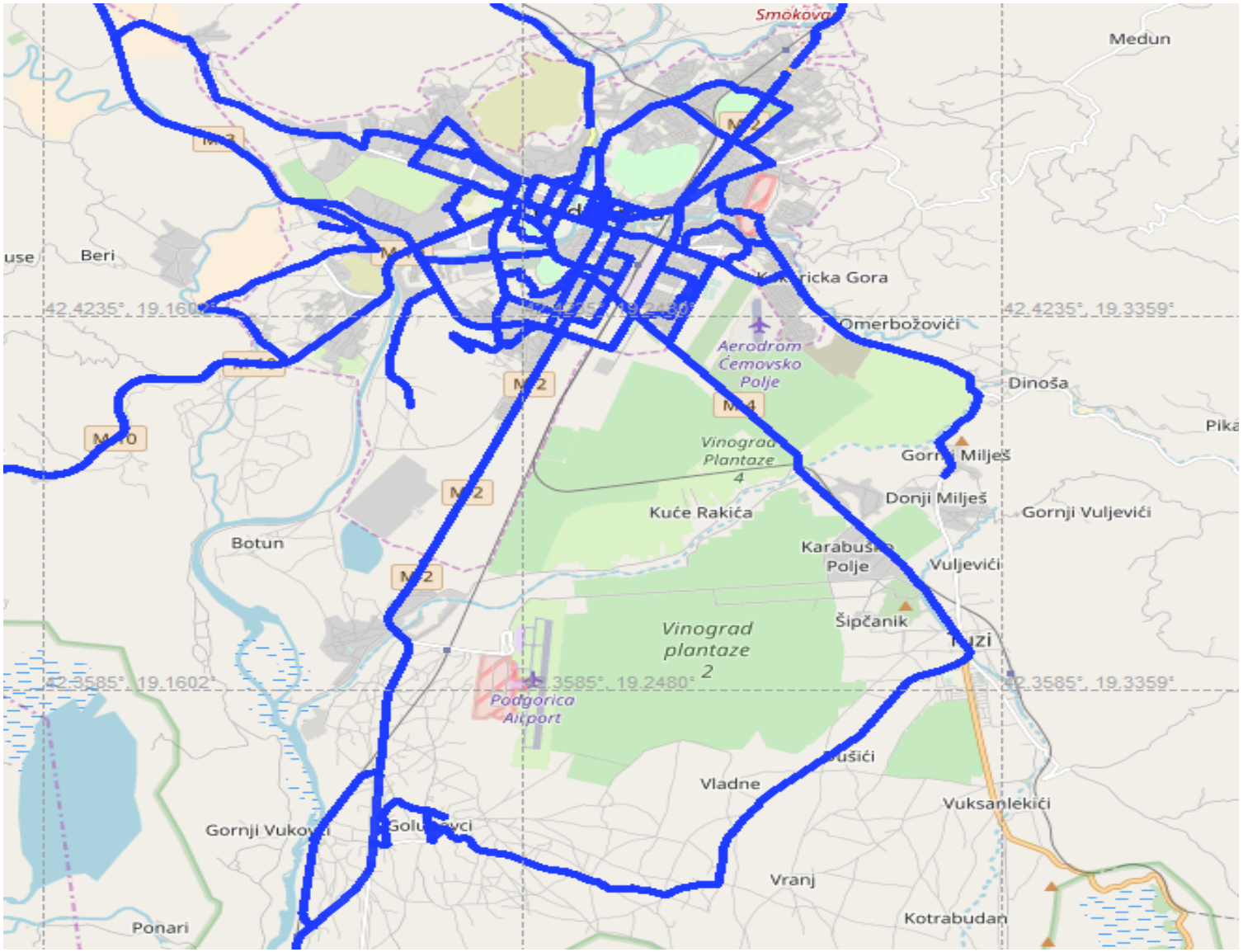
❖Results analysis for data service, depending of the parameters group (parameters for network acces and parameters for service usage possibility or parameters which give the picture about measured speed) and the type of the service (FTP or HTTP) appropriate number of the samples was taken so the width of the confidance interval be smaller then 3% for the result confidance level off at last 95 %.

- Measuring route included urban parts of all municipalities (23) and all main roads:

  - Podgorica – Danilovgrad – Nikšić – Plužine – Šćepan Polje
  - Nikšić – Vilusi – Lipci
  - Podgorica – Cetinje – Budva
  - Podgorica – Virpazar – Petrovac (preko Paštrovačke gore i preko tunela Sozina)
  - Ada Bojana – Ulcinj – Bar- Budva – Tivat – Kotor- Herceg Novi – Debeli Brijeg
  - Nikšić – Žabljak – Pljevlja – Ranče
  - Đurđevića Tara – Mojkovac
  - Podgorica – Kolašin – Mojkovac – Bijelo Polje – Dobrakovo
  - Ribarevine – Berane – Rožaje – Dračenovac
  - Berane – Andrijevica – Plav – Gusinje
  - Berane – Petnjica

- During the measurement campaign in municipalities and the main roads measuring staff was past about 2600 km and on effective measurements was spent about 85 hours.


Пријепоље
Nacionalni park Sutjeska
Сјеница
Gacko
Нови Пазар
Тутин
Istog
Crna Gora / Црна Гора
Rajoni i Pejës (03) / Okrug Peć (03)
Deçan
Ubli
Parku Kombëtar Lugina e Valbonës
Rajoni i Gjakovës (07) / Okrug Đakovica (07)
Bajram Curri
Nikaj-Mertur
Nacionalni park Skadarsko jezero
Parku Nacional i Liqenit të Shkodrës
Shkodra
Kukës
Lumi Buna-Velipojë
Parku Natyror Korab Koritnik


Smokovac
Medun
Beri
42.4235°, 19.1602°
42.4235°, 19.3359°
Omerbožovići
Aerodrom Ćemovsko Polje
Dinoša
Vinograd Plantaze 4
Donji Milješ
Gornji Vuljevići
Kuće Rakića
Botun
Karabuška Polje
Vuljevići
Šipčanik
Vinograd plantaze 2
42.3585°, 19.1602°
42.3585°, 19.2480°
42.3585°, 19.3359°
Podgorica Airport
Vladne
Vuksanlekići
Gornji Vukovci
Vranj
Kotrabudan
Ponari

Conclusions and important facts

- Measuring results for voice and data service parameters show the high level of quality for the mentioned sevices
- Relatively bad parameter, Telephony Setup Time, was measured for the operator M:tel mobile network which value was higher then 6s for 15,32% established voice calls. That was not the case for the other two mobile networks.
- FTP {Download|Upload} Data Transfer Cut-off, for the FTP upload on the roads, have very high values in the operator M:TEL mobile network (24,71%) and operator Telenor mobile network (22,82%), while that parameter value in the operator Crnogorski Telekom mobile network is on acceptable 6,76% level. These values are better in the municipalities urban areas where we have values 15,88% for operator M:TEL mobile network, 1,47% for operator Crnogorski Telekom mobile network and 6,77% for operator Telenor mobile network.
- Not so good values for parameter PDP Context Activation Success measured in operator Crnogorski Telekom mobile network and also not so good values for parameter PDP Context Cut-off measured in operator Telenor mobile network, do not have important impact on overall result when the usage of GSM and UMTS technologies for the data services is taken into account, 15% for the operators Crnogorski Telekom i M:Tel and 6,5 for the operator Telenor

- Measuring results for the data transfering speeds show very high speeds as for download so for upload and these speeds are comperable with the speeds which are offered in networks for fixed internet acces
  - FTP mean data rate for **download per session** in urban municipalities area, when the sample is one session, have value 30,45 Mb/s for operator M:tel mobile network, 43,3 Mb/s for operator Crnogorski Telekom mobile network and 55,2 Mb/s for operator Telenor mobile network, while these speeds for the main roads have values 19,5 Mb/s, 32,45 Mb/b and 24,6 Mb/s, respectively
  - Results for parameter FTP mean data rate **download per session** show that the transfer data speed in 90 % of samples, in urban municipalities areas, had values 13 Mb/s or higher for operator M:tel mobile network, 16,85 Mb/s or higher for the operator Crnogorski Telekom mobile network and 15,7 or higher for te operator Telenor mobile network
  - FTP mean data rate for **upload per session** in urban municipalities area, when the sample is one session, have value 16,95 Mb/s for operator M:tel mobile network, 34,66 Mb/s for operator Crnogorski Telekom mobile network and 37,53 Mb/s for operator Telenor mobile network, while these speeds for the main roads have values 11,77 Mb/s, 23,9 Mb/b and 17,8 Mb/s, respectively

- Results for the parametar FTP mean data rate **upload per session** show that the transfer data speeds for 95 % of samples in urban municipalities areas had values 4,93 Mb/s or higher in operator M:tel mobile network, 14,76 Mb/s or higher for the operator Crnogorski Telekom mobile network and 12 Mb/s or higher for operator Telenor mobile network

- The shortest value for the Telephony setup time was 1,498 s mesured in the operator Telenor mobile network
- Maximum speed on session basis which is measured during the measurement campaing was 162 Mb/s on downlink and it was measured in operator Telenor mobile network, while on uplink the maximum measured speed was 81 Mb/s in operator Crnogorski Telekom mobile network
- Tacking in acount above mentioned benchmarking results could be assumed that all conditions from approvals which are issued based on spectrum auction from 2016 are satisfied and more. Also we see the space and exspect further improvement for data transfer speeds, specialy if tackes in acount that all network providers use in more than 80 percent LTE technology but LTE advanced technology trough Carrier aggregation (CA) is used in higher percent only by operator Telenor (almost 50 %).

2017 and 2015 measuring results comparation

- In 90% downlink measuring sessions measured speed in 2015 benchmarking campaign, for the operator mobile network with worst result, the measured speed was 1 Mb/s and higer, while in 2017 benchmarking campaign the measured speed was 5 Mb/s and higher, while in the case of the operator with the best result measured speed for the same percent in 2015 was 2,5 Mb/s and higher, while in the 2017 the measured speed was 7Mb/s or higher
- In 50% downlink measuring sessions measured speed in 2015 in the operator mobile network with worst result the measured speed was 5 Mb/s and higer, while in 2017 the measured speed was 22 Mb/s and higher, also in the case of the operator with the best result the measured speed for the same percent in 2015 was 17 Mb/s and higher, while in the 2017 the measured speed was 36 Mb/s or higher
- Servicies trasintion depending of the mobile technology. 2017 measurements show that for data services now the main tecnology is LTE/LTE Advanced technology (round 85% for operator M:tel, round 86% for operator Crnogorski Telekom and round 93% for operator Telenor looked over all collected measurement samples), while measurements 2015 show roughly that these percents were in favor of UMTS technology. The situation is almost similar for voice service where measurements 2017 show that the UMTS technology now is primary while measurements 2015 show that GSM technology is used in mach higher percent.

Questions?

Thanks for your attention!
Thanks to meeting organizers for a given time!